EXPERIMENT 7: HOW IS MASS RELATED TO INERTIA?
SIMPLE HARMONIC OSCILLATOR

PURPOSE:
Investigate the relationship between mass and inertia. Using the period of an oscillating spring to find the mass of an object.

MATERIALS:
Masses of 100g, 50g, 200g, Spring, ring Stand for the spring, Stop watch. 2 Unknown masses (less than 300g), digital scale (max at least 200g).

interesting to watch: https://www.youtube.com/watch?v=8rt3udip7l4

DATE______________

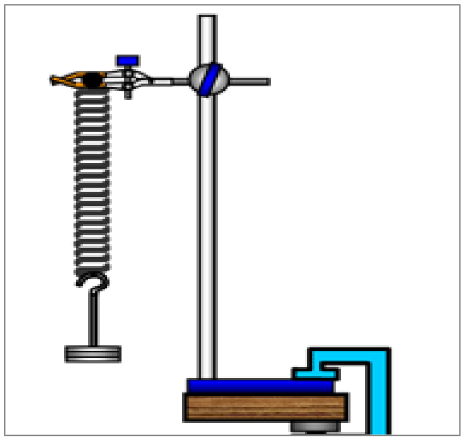
AUTHOR ____

PARTNER ____

PARTNER _______________________________________

BACKGROUND:

Newton's fist law states that an object at rest tends to remain at rest, while an object in motion tends to remain in motion. This property of matter is called inertia. An inertia balance is a device that make use of this property to determine the mass of an object. The period of an inertia balance is directly related to the amount of mass attached to the balance. The period is the amount of time it takes for one complete swing of the balance. You will use an oscillating spring called a balance to determine mass. Physicists call such a device a harmonic oscillator.



PROCEDURE:

1) Have the spring and the mass holder on the stand.
2) Place 100g on the mass holder . the spring stretches too much, pick a smaller weight like 50g or even 20g. Record the total mass in TABLE1.
3) Pull the inertia balance back and then release it. Use the stopwatch to time 10 complete swings. Make sure the mass does not rub against the stand. Pull vertically. Record the time in TABLE 1.
4) Add 100g (or less) mass to the balance and record the total mass in the TABLE 1.
5) time 10 swings of the balance. Record your time in TABLE 1.
6) Repeat those steps (3 to 5). Don't overstretch the spring.

TABLE1:

Total mass (g) X-AXIS	Time for 10 swings (sec)	Period (sec) T	Period^2 (sec^2) T^2 y-AXIS
100g (on holder)			
200 (on holder)			
300 (on holder)			
350 (on holder)			

7) Repeat step 3 for the two unknown masses (ask instructors). Report in TABLE2

TABLE 2

Mass (g)	Time for 10 swings	T=Time for 1 swing	T^2
Unknown mass 1			
Unknown mass 2			

!! KEEP the unknown mass. You will need them at the end.

COMPUTATION:

1) Calculate the period by using the following formula:

period T = time for 10 swings/10

record the data in TABLE 1. Do the same in TABLE 2.

2) Calculate the period squared (notation is T^2)

record in TABLE 1. Do the same in TABLE 2.

3) There is a relationship between the period T (time for a cycle) and the mass attached to the spring:

$$\boxed{\text{period} = 2\pi\sqrt{\frac{\text{mass}}{K}}} \qquad \boxed{T = 2\pi\sqrt{\frac{m}{K}}}$$

K is a constant called the spring constant and it depends on the stiffness of the spring. Stiffer is the spring (more springer), smaller is the period (oscillations are faster). If you square both sides of the equation you get :

$$\boxed{T^2 = 4\pi^2\frac{m}{k}}$$

The equation shows a linear relationship between the period squared and the mass. So if you graph the *period squared* versus the *mass*, you get a straight line. Note: The mass m included the 50g holder. So m is really mass added +50. This is why the line has an y-intercept.

USE TABLE 1

With a spreadsheet make a scatter plot of ***period squared*** *T^2 (y-axis)* versus ***mass*** *(x-axis)*. Trace the best fit line and don't forget to display equation on the graph.

The equation is : T^2 = ___ . mass + _____ (or y = ___ x + _____ same thing).

ANALYSIS:

1) USE **<u>TABLE 2 AND use your graph</u>** to find the mass of the two unknown masses.

`Note: you can also use the equation of the line.`

From the graph, you get experimental mass 1 = _______ g

From the graph, you get experimental mass 2 = ______ g

2) Use a digital scale to find the accepted masses (true values)

accepted mass 1 = ________g

accepted mass 2 = ________g

3) Compute the percent discrepancy for mass 1 and mass 2 between the actual values and the experimental values. (|predicted – experimental| /predicted)x 100

Percent discrepancy1=___________ %

Percent discrepancy2 = _________ %

4) How did the period change as the mass on the balance changed ? (increasing the mass means increasing the inertia, means increasing the resistance to a change in motion)

5) How did you use your graph to determine the masses of the unknowns ?

6) What the video: https://www.youtube.com/watch?v=P-Umre5Np_0

This demo shows the position of the mass as a function of time. The mass is undergoing a harmonic motion similar to your experiment. What is the graph of the position versus time ? (how is it called in Math). Draw below :

7) The motion you observed is called a simple harmonic motion. Go on line and find the definition of harmonic motion.

8) Go on line and find the definition of inertia.

8) go to wolfram alpha https://www.wolframalpha.com/ In the box type :

plot sin(2pix/4) for x between 0 and 12

The graph represents again a harmonic motion. Can you see the cycles that repeat themselves ?

What is the period of that motion ? ____________

What do you think the equation is if the period is 3 ? _____________ .

Check if you are right by using again wolfram alpha.

CONCLUSION: (separate paper) Was the purpose of this lab accomplished ? Why or Why not ?(your answer to this question should show thoughtful analysis and careful, through thinking)